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ABSTRACT

In 1972, the Ministry of Education in the Republic of China gave the Taiwan Provincial Institute for Elementary School Teachers Inservice Education primary responsibility for research and development (R&D) for all elementary school curricula. The project in science and mathematics was carried out in two phases. Phase I, R&D, has five stages: (1) "The Planning Stage," establishing an R&D committee gathering relevant curriculum data from local and foreign sources; (2) "The Design Stage," determining the curriculum model, teaching methods, and design of instructional media; (3) "The Development Stage," conducting three local and nationwide studies with teacher training and three revisions; (4) "The Pilot and Evaluation Stage"; and (5) "The Implementation Stage," including nationwide teacher training. Phase II focused on dissemination, implementation, and evaluation. Six unique aspects of this curriculum project are emphasized. (YP)

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Curriculum Research, Development & Implementation in Elementary School Science and Mathematics in the Republic of China

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CURRICULUM RESEARCH, DEVELOPMENT & IMPLEMENTATION IN ELEMENTARY SCHOOL SCIENCE AND MATHEMATICS IN THE REPUBLIC OF CHINA

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I. Introduction

Research and development of elementary school science education in the Republic of China has been a continuous process, but truly comprehensive long term projects did not begin until the 1970s. In 1972 the Ministry of Education gave the Taiwan Provincial Institute for Elementary School Teachers' Inservice Education primary responsibility in research and development of all elementary school curricula. The first projects conducted by the Institute were in the science and mathematics curricula. Both were large scale and long term in nature using the same systematic approach. This approach is characterized by extensive nationwide pilot study, comprehensive teacher training, a large degree of standardization and strict quality control. The R & D Committees spearheading the projects paid meticulous attention to every aspect of curriculum and teaching, including the production of all textbooks, workbooks, manuals, reference books and instructional aids which were developed by the Institute and disseminated to all ROC elementary schools. Another important characteristic of the projects is that researchers and curriculum specialists work side by side with the best school teachers in the country in order to obtain maximum practitioner input during R & D work.

The projects in science and mathematics were carried out in two phases. Research and development work were conducted in Phase I while Phase II focused on dissemination, implementation and evaluation. Phase I of the science project was conducted between 1972 and 1979. It is now into the fourth year of its second phase. The mathematics project completed Phase I between 1974 and 1982 and is in the second year of Phase II. Thus, elementary school curriculum development projects in the Republic of China are truly long range projects that require massive planning, continuous coordination and genuine financial commitment as well as the dedication and cooperation of the entire elementary school system and the entire network of teachers colleges.

II. Phase I of the ROC Curriculum R & D Projects

The five stages of Phase I are the planning stage, the design stage, the development stage, the pilot and evaluation stage, and the implementation stage. This sequential research, development and implementation procedure was followed for curriculum development into all grade levels, but the timing was different for materials of different grade levels so that the five stages overlap each other considerably in time. The initial planning encompassed all grade levels, but the curricula for the first grade were designed, developed, piloted and implemented first. For example, when the first grade materials were being piloted in 1976, the work on third grade materials was still in the development stage.

The first nationwide use of the new curricula began in September 1978. In that year it was only implemented at the first grade level. Nationwide adoption of the new curriculum at the second grade level commenced in 1979, and the third grade in 1980 and so on until this past September when all grades in all elementary schools began to use the new science and mathematics curricula.

Such a workplan distributes media production and the complex coordination of teachers' inservice training over the years. This systematic approach also increases the effectiveness of the implementation of the new curricula because the R & D Committees can concentrate its efforts on one grade level at a time.

We now turn to a closer look at the tasks in each stage of Phase I, which are listed in Figure 1.

1. The Planning Stage

The planning stage begins with the establishment of an R & D Committee. The R & D Committee for natural science was established in 1972, followed by the mathematics Committee in 1974. Both Committees consisted of educators, psychologists, curriculum specialists, media experts, select elementary school teachers as well as professors from the respective academic disciplines. These people participated in all stages of the projects at the Institute. The Committees' first tasks were to gather relevant existing curriculum data from local and foreign sources. These data were supplemented by new data from questionnaires and interviews conducted by the Committee. These reference materials formed the foundation for the next stage.

2. The Design Stage

The design stage is the most important in R & D work. The curriculum model, the teaching methods and the designs of all instructional media were determined in this stage. The reference materials collected in the planning stage were analyzed and many potential curriculum models were closely examined for possible adoption. After many discussions and consultations, the basic models for the science and mathematics curricula were constructed. Within the models adopted, the entire domains for the science and mathematics curricula were mapped out with curriculum goals laid down for each unit. Furthermore, the principles for choosing, structuring, organizing and evaluating the contents of the curricula were determined at this stage. Since these models and principles must guide the work in the next three stages, they were chosen and constructed with the greatest of care. The designs underwent elaborate field testing and numerous revisions at evaluation conferences.

3. The Development Stage

Based on the overall model and the principles set up in the design stage, the R & D Committees developed first drafts of the new curriculum. This work relied most heavily on the experience of the elementary school teachers in the Committees. The drafts paid attention to every instructional detail. For example, the teachers' manuals contained subgoals for each instructional unit along with step by step descriptions of the instructional method to use for the unit. Special learning activities and behavioral goals were also specified for each unit. The detailed first drafts of the new curricula must be repeatedly tested and pass the scrutiny of all Committee members at evaluation conferences held before and after field testing. Finally, provisional curricula were printed up for the first nationwide pilot study.

The non print instructional materials were also produced and evaluated at the same time. Due to the small market in Taiwan for instructional aids, manufacturers are often unwilling or unable to invest in research and development of teaching aids. Therefore, the R & D Committees at the Institute must also design and field test all instructional media along with the basic textbooks and teaching methods. The instructional aids were manufactured by selected vocational and technical schools around the country. This production program provides technical students hands-on experience, increases the meaningfulness and importance of their school projects and elevates their basic production skills. This is an important side effect of our curriculum development project and a unique characteristic of the curriculum development process in the ROC.

4. The Pilot and Evaluation Stage

After receiving the stamp of approval from all members of the R & D Committee, the provisional curricula were piloted, evaluated and revised three times.

The first pilot studies were conducted at local schools by members of the R & D Committee. The teachers' experience in using the new curricula and their observations of student response formed the basis for the first major revision of the provisional curricula. The more extensive second pilot studies were then conducted using the revised provisional curricula.

The second pilot studies were nationwide studies. They began with the selection of representative experimental schools. The natural science project selected 48 experimental schools from all over the province. Another 48 schools participated in the mathematics project.. One class in each experimental school participated in the second pilot study. First their classteachers were trained for three weeks at the Institute on the use of the revised provisional curricula. Then the provisional curricula were piloted for one year at the experimental schools. During the year, some members of the R & D Committee visited the individual experimental schools to give additional guidance and to conduct demonstration classes on the provisional curricula. After the curricula were tested for one year, a questionnaire survey was distributed to solicit expert advice and reaction to the pilot study. An evaluation conference attended by one representative from each experimental school was then held to analyze the survey data and other information gleaned from the teachers' actual use of the curricula. Out of these conferences came decisions on what to add, delete or revise in the revised provisional curricula. This was the second revision of the new curricula.

The far reaching impact of the curriculum reform in the ROC demanded even further testing, so an even more extensive third pilot study was carried out. This time 63 other schools were selected for both the natural science and the mathematics projects. In the third pilot studies, all classes in the selected schools used the experimental curricula, as opposed to only one class in each school in the second pilot. Again, all the teachers from the experimental schools received three weeks of intensive training on the new curricula at the Institute. They also received additional guidance and attended demonstration classes during the one year duration of the third pilot study.

The third pilot studies used evaluation data from comparisons of student learning outcomes, opinion surveys of elementary school teachers as well as student attitudes and reactions toward the new materials.

Throughout all iterations of the teacher training, pilot study, evaluations and revisions, the instructional aids such as workbooks, slides, laboratory kits and reference books were tested, evaluated and refined along with the experimental teaching. When teachers were trained at the Institute, they were distributed experimental teaching aids so that they might learn how to use the new media and then take them back to their schools for testing.

5. The Implementation Stage

After three pilot studies, three evaluations and three revisions, the curricula were considered ready for nationwide experimental adoption. Full scale implementation began with a one week seminar for the professors from the relevant departments of teachers colleges around the country. After that, every ROC elementary school teacher was trained in the new curricula in one of two ways. The teachers from specially selected demonstration schools were trained at the Institute for three weeks during the school year while substitute teachers took their place at work. Teachers from all other schools were trained for two weeks during summer and winter vacations by professors from the teachers colleges who had attended seminars at the Institute. All instructional media in the form of textbooks, laboratory manuals, workbooks, teachers' manuals, teachers' reference books, slides, laboratory kits and other instructional aids were distributed to teachers during training sessions.

Videotapes were used extensively for teacher training. The videotapes were distributed to the professors at teachers colleges to be used in three ways. First, the professors could familiarize themselves with the new curricula using the videotapes. Secondly, the videotapes can be used during inservice teachers education conducted at the teachers colleges. Finally, they are used in preservice education so that all graduates from teachers colleges are well acquainted with the experimental curricula.

After all the teachers had been specially trained to use the experimental curricula, full scale nationwide experimental adoption took place. The teachers were given further assistance during implementation.

III. Phase II of the ROC Curriculum R & D Projects

Our curriculum development projects do not end with implementation, but continues into a predominantly evaluative phase. In Phase II of the curriculum development projects, the main goals are:

1. Thorough implementation of the new curricula.
2. Development of suitable instruments for evaluating student outcomes.
3. Collection of normative data on student ability to learn natural science and mathematics.

In Phase II of curriculum development, we are concerned with whether the teachers are actually using the method and media that have been painstakingly developed and tested. To ensure proper implementation, continued guidance is necessary. This is done in several ways:

1. Demonstration schools have been established as local centers of dissemination. There are 37 demonstration schools for mathematics and 91 schools for natural science distributed throughout the Taiwan area. Training of demonstration school teachers in the new curricula continue at the Institute.

2. Members of the R & D Committee make periodic visits to local schools to provide assistance and explanations concerning the new curricula.

3. Each teachers college is responsible for servicing the teachers in its supervisory district that covers several counties and cities.

4. Members of elementary schools teachers services corps and supervisors at various levels of the county, city and provincial departments of education pay regular visits to the schools to give constant information, service and guidance. A Provincial Elementary School Teachers Service Corps was set up in August 1983 as part of the increased effort at thorough implementation.

Altogether, the teachers receive information, assistance and guidance concerning the new curricula from four sources: the Institute, the elementary school teachers services corps of the county and city departments of education, the teachers colleges and from the new Provincial Elementary School Teachers Services Corps. In this way, the implementation effort affects not only teachers and the students in their classrooms but also the entire elementary school system, the teacher education process and all teachers services and administrative networks.

At the same time, research continues at the Institute on assessment instruments. Since the new curricula emphasize physical manipulation during learning as opposed to passive acceptance of the teachers' lectures, new assessment instruments emphasize manipulative tests rather than paper and pencil tests of student learning.

IV. Unique Aspects of the ROC Curriculum Projects

This standard curriculum development process is followed for all subject areas at the elementary level. Reaction to this process has been extremely favorable. Its success is due mainly to several unique aspects of the process that are worth mentioning here.

1. One of the important reasons for project success is the fact that the ROC government oversees all phases and stages of the project. Under government sponsorship, the projects can engage the best minds in the nation to maintain overall high standards and quality control. Further, standardization of the instructional media greatly reduces expenses while maximizing accuracy and efficiency.

A few facts and figures will provide a sense of the scale of these projects. In 1972, at the inception of the projects, there were 2,349 elementary schools in the ROC with a total of 49,333 classes and 61,517 teachers. Now, in 1983, we have 2,557 elementary schools with 50,715 classes and the number of teachers have increased to 70,055. Each one of these 70,055 teachers and others who have left the elementary school system were specially trained in the new curricula. Without government participation, it is doubtful that a new curriculum that makes an impact on every elementary school teacher and school child can be fully coordinated.

The number of pupils have decreased slightly over the years. In 1972 there were over 2.4 million elementary school students, representing 155 per thousand of the ROC population. By 1983, the number has decreased to 2.2 million or 120 per thousand of the country's population. The increase in the number of teachers, accompanied by a decrease in number of pupils has changed the student teacher ratio from almost 40 to 1 to 31 to 1. Therefore, in 1983, the ROC can boast of better elementary school education in several ways: lowered student teacher ratio, better trained teachers and brand new science and mathematics curricula.

2. A second reason for the success of our curriculum development projects is that instructional design has progressed hand in hand with instructional practice. This is true is two ways. First of all, elementary school teachers participate in every stage of the design process so that the practical experience from actual use of the curricula can be incorporated. Secondly, every teacher has been given an opportunity to provide input into the project through questionnaire surveys conducted by the R & D Committees after every pilot study. Additional teacher input is obtained during the teacher training sessions.

3. The successful implementation of a curriculum reform project depends heavily on changing teachers. We have tried to do so in two ways. First, we have made sure that every teacher is given several weeks of intensive training on the new curriculum before using it. Subsequently, they are given continuous assistance during actual teaching. We realize that although much time and energy have been expended to communicate the new methods and new ideas to the teachers, most of them were trained on the old curricula and old ways are not easy to discard. Therefore, our best hope for eventual success is to thoroughly train a new generation of teachers. To this end, we have amassed the cooperation of the nine teachers colleges around the country, familiarized their professors with the new materials and supplied them with preservice training tools such as videotapes. Every teachers college has been disseminated 77 videotapes for natural science teacher education and 30 videotapes for mathematics teacher education.

4. Another unique feature that has contributed to project success has been in the ways instructional media are researched, designed, produced and tested along with the teaching method. The current science and mathematics curricula have been systematically designed to make maximal use of audiovisual and other instructional aids and the emphasis on design, production and dissemination of instructional media has become one of the distinctive features of the curriculum development process.

5. The years of careful piloting have also paid off. We believe that the choice of representative schools for the pilot studies contributed tremendously to the subsequent smooth implementation. The schools for the second and third pilot studies and the demonstration schools are widely dispersed throughout the Taiwan area and cover urban, rural, suburban, mountain and coastal districts. This means that the materials developed are suitable for use in all part of the country and all types of children, making the way for easier implementation.

6. Our curriculum development process is probably the most economical in the world. For the two projects, the ROC government spent US $10.5 million, of which $7.5m went into producing instructional aids, $1.5m for teacher education at the teachers colleges and another $1.5m for research and development, teacher education and other work at the Institute. All other expenses such as salaries for substitute teachers, printing of textbooks etc. have been absorbed by the annual budget allocated to the schools and the various branches of educational administration. This translates into less than five US dollars spend on each elementary school child in order to develop and implement the two new curricula. A successful curriculum development and implementation project need not be costly. What it takes cannot be assessed in terms of dollars and cents. It can only be seen in the patience and persistence of project workers and the teachers and students who have made it work.

V. Conclusion and Acknowledgements

We do believe that these are exemplary projects that have put elementary education in the ROC one step forward. Since these are our first efforts, we are reporting our achievement at this time only to serve as a reference for future attempts at curriculum development and implementation. While we are gratified by the success of the projects so far, much remains to be done and we hope that the achievements of Phase II will outstrip those of Phase I.

Comprehensive and long range projects require much sacrifice and dedication from many different sources. We have been fortunate in the science and mathematics projects to have received enthusiastic support from all project participants and silent support from countless others whose lives and work have been affected. I would like to take this opportunity to thank them for their patience, tolerance, support and contributions during all the previous years of the projects and for the help they are about to give in the years to come.

Specifically, I would like to acknowledge the contributions of the following people and institutions:

1. All personnel at all levels of the educational administration in the ROC government.

2. The presidents and professors of the universities and colleges, especially those who participated as members of the R & D Committees.

3. The school teachers who have made all the plans and designs come to life in our students, especially those teachers who served on the R & D Committees.

4. The National Institute of Compilation and Translation, which has edited and published all the experimental materials in the projects.

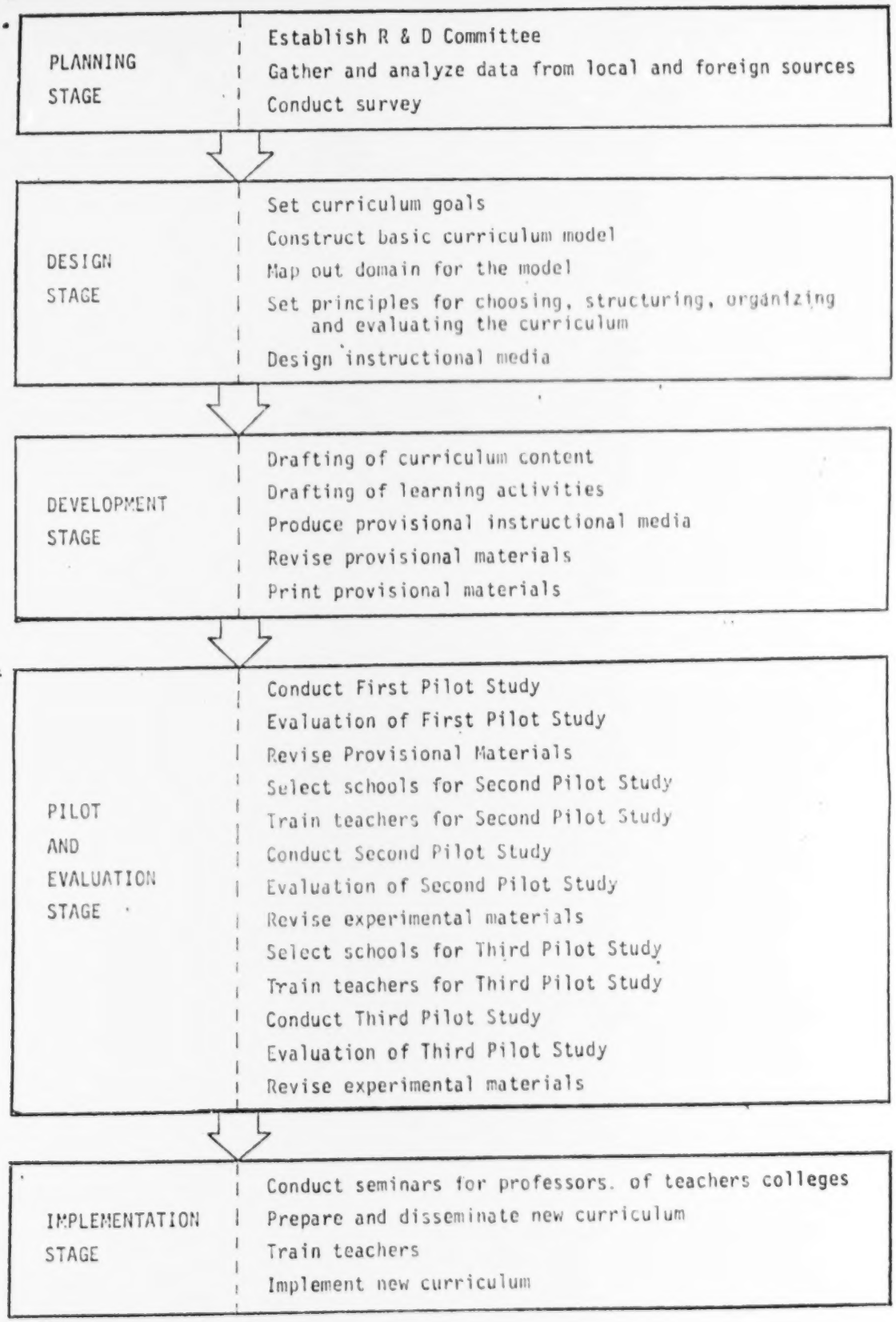
PLANNING STAGE
Establish R & D Committee
Gather and analyze data from local and foreign sources
Conduct survey
DESIGN STAGE
Set curriculum goals
Construct basic curriculum model
Map out domain for the model
Set principles for choosing, structuring, organizing and evaluating the curriculum
Design instructional media
DEVELOPMENT STAGE
Drafting of curriculum content
Drafting of learning activities
Produce provisional instructional media
Revise provisional materials
Print provisional materials
PILOT AND EVALUATION STAGE
Conduct First Pilot Study
Evaluation of First Pilot Study
Revise Provisional Materials
Select schools for Second Pilot Study
Train teachers for Second Pilot Study
Conduct Second Pilot Study
Evaluation of Second Pilot Study
Revise experimental materials
Select schools for Third Pilot Study
Train teachers for Third Pilot Study
Conduct Third Pilot Study
Evaluation of Third Pilot Study
Revise experimental materials
IMPLEMENTATION STAGE
Conduct seminars for professors of teachers colleges
Prepare and disseminate new curriculum
Train teachers
Implement new curriculum

Figure 1 Tasks in the Curriculum Research, Development and Implementation Process for Elementary Education in the ROC